

WHAT IS CLAIMED IS:

- 1 1. A method of performing heart surgery, the method comprising:
2 accessing a heart of a patient through a first incision on the left thorax of the
3 patient;
4 contacting the heart, through the incision, with at least one of a heart
5 stabilizing device and a heart positioning device;
6 introducing at least one coupling device through a second incision on the
7 patient located apart from the first incision;
8 coupling the at least one coupling device with at least one of the heart
9 stabilizing device and the heart positioning device; and
10 performing a surgical procedure on the heart.
- 1 2. A method as in claim 1, wherein the first incision is located between
2 two ribs of the patient.
- 1 3. A method as in claim 1, wherein accessing the heart comprises
2 widening the first incision using at least one retractor device.
- 1 4. A method as in claim 3, wherein accessing the heart further comprises
2 widening a space between two ribs using the retractor device, and wherein the retractor
3 device includes means for inhibiting damage to a nerve while widening the space between the
4 ribs.
- 1 5. A method as in claim 1, wherein the contacting step comprises
2 contacting the heart with a heart stabilizing device and a heart positioning device.
- 1 6. A method as in claim 5, further comprising using suction force to
2 enhance contact of the heart stabilizing device and the heart positioning device with the heart.
- 1 7. A method as in claim 1, further comprising rigidifying at least a
2 portion of the coupling device.
- 1 8. A method as in claim 7, wherein rigidifying comprises applying a
2 vacuum force to at least a portion of the coupling device.

1 9. A method as in claim 1, wherein the introducing and coupling steps
2 comprise:
3 introducing a first elongate coupling device through the second incision; and
4 coupling the first elongate coupling device with the heart stabilizing device.

1 10. A method as in claim 9, further including:
2 introducing a second elongate coupling device through a third incision on the
3 patient at a location apart from the first and second incisions; and
4 coupling the second elongate coupling device with the heart positioning
5 device.

1 11. A method as in claim 10, further including coupling each of the first
2 and second elongate coupling devices with at least one stabilizing apparatus for stabilizing
3 the coupling devices.

1 12. A method as in claim 11, wherein coupling the coupling devices with
2 the stabilizing apparatus comprises:
3 coupling the first coupling device with a first stabilizing arm;
4 coupling the second coupling device with a second stabilizing arm; and
5 coupling the first and second stabilizing arms with at least one static object.

1 13. A method as in claim 12, wherein the static object comprises at least a
2 portion of an operating room table.

1 14. A method as in claim 12, wherein the static object comprises a rib of
2 the patient.

1 15. A method as in claim 12, wherein the static object comprises a
2 retractor used to widen the first incision.

1 16. A method as in claim 12, further including rigidifying the first and
2 second stabilizing arms.

1 17. A method as in claim 1, further comprising applying suction force with
2 at least one of the heart stabilizing device and the heart positioning device to enhance contact
3 between the device(s) and the heart.

1 18. A method as in claim 1, wherein performing the surgical procedure
2 comprises performing a coronary artery bypass graft procedure.

1 19. A method as in claim 1, wherein the step of coupling the at least one
2 coupling device with at least one of the heart stabilizing device and the heart positioning
3 device takes place within the chest cavity of the patient.

1 20. A system for enhancing minimally invasive heart surgery, the system
2 comprising:
3 at least one retractor device for enhancing access to a patient's heart through a
4 first incision;
5 a heart stabilizing device having a tissue contacting surface and at least one
6 suction aperture adjacent the surface; and
7 a first coupling device for coupling with the heart stabilizing device through a
8 second incision at a location on the patient apart from the first incision.

1 21. A system as in claim 20, further comprising:
2 a heart positioning device having a tissue contacting surface and at least one
3 suction aperture; and
4 a second coupling device for coupling with the heart positioning device
5 through a third incision at a location on the patient apart from the first and second incisions.

1 22. A system as in claim 21, wherein the first and second coupling devices
2 each comprise an elongate shaft having a proximal end, a distal end and means for coupling
3 with the heart stabilizing device or the heart positioning device adjacent the distal end.

1 23. A system as in claim 22, wherein the means for coupling comprises a
2 collet or socket for coupling with a ball on the heart stabilizing device or the heart positioning
3 device.

1 24. A system as in claim 23, wherein each of the first and second coupling
2 devices further include a tightening device adjacent the proximal end of the shaft, for
3 tightening the collet or socket around the ball.

1 25. A system as in claim 22, wherein the means for coupling comprises a
2 slot for coupling with a surface feature on the heart stabilizing device or the heart positioning
3 device.

1 26. A system as in claim 22, wherein the means for coupling comprises
2 threads for coupling with complementary threads on the heart stabilizing device or the heart
3 positioning device.

1 27. A system as in claim 22, wherein the means for coupling comprises a
2 clamp for coupling with the heart stabilizing device or the heart positioning device.

1 28. A system as in claim 22, wherein the elongate shaft comprises at least
2 one flexible joint between the proximal end and the distal end.

1 29. A system as in claim 28, wherein the at least one flexible joint
2 comprises at least one collet or socket and ball joint.

1 30. A system as in claim 22, wherein the elongate shaft comprises at least
2 one flexible, rigidifying portion.

1 31. A system as in claim 30, wherein the rigidifying portion is rigidified by
2 applying suction.

1 32. A system as in claim 21, further comprising:
2 a first flexible arm for coupling the first coupling device with at least one
3 stable object; and
4 a second flexible arm for coupling the second coupling device with the at least
5 one stable object.

1 33. A system as in claim 32, wherein the first and second flexible arms
2 may be rigidified after coupling the first and second coupling devices with the stable object.

1 34. A system as in claim 32, wherein the at least one stable object
2 comprises at least one part of an operating room table.

1 35. A system as in claim 32, wherein each of the first and second flexible
2 arms comprises:

3 an elongate arm having a proximal end, a distal end and at least one joint
4 disposed between the proximal end and the distal end;
5 means near the distal end for coupling the arm with a coupling device;
6 means near the proximal end for coupling the arm with the stable object; and
7 means for rigidifying the at least one joint of the arm.

1 36. A system as in claim 35, wherein the means near the distal end and the
2 means near the proximal end each comprises a clamp.

1 37. A system as in claim 20, wherein the at least one retractor device
2 comprises:
3 a retractor frame for movably holding at least two retractor blades;
4 at least two retractor blades coupled with the retractor frame, for retracting
5 tissue adjacent an incision; and
6 means for moving the retractor frame so as to move the blades to retract the
7 tissue.

1 38. A system as in claim 37, wherein each of the at least two retractor
2 blades includes nerve protection means for inhibiting damage to an intercostal nerve when
3 retracting a rib.

1 39. A system as in claim 37, wherein the means for moving the retractor
2 frame comprises a crank handle.

1 40. A system as in claim 20, wherein the heart stabilizing device
2 comprises:
3 at least one tissue contacting surface;
4 at least one suction aperture for applying suction force to enhance contact
5 between the tissue contacting surface and heart tissue; and
6 at least one suction port for connecting with a source of suction.

1 41. A device for enhancing minimally invasive heart surgery, the device
2 comprising:
3 a surgical tool; and
4 an elongate coupling member having a proximal end, a distal end and means
5 near the distal end for coupling with the surgical tool.

1 42. A device as in claim 41 wherein the surgical tool is a heart stabilizing
2 member.

1 43. A device as in claim 42, wherein the heart stabilizing member
2 comprises:
3 at least one tissue contacting surface;
4 at least one suction aperture for applying suction force to enhance contact
5 between the tissue contacting surface and heart tissue; and
6 at least one suction port for coupling with a source of suction.

1 44. A device as in claim 42, wherein the heart stabilizing member
2 comprises:
3 at least one inflatable tissue contacting surface; and
4 at least one port for allowing inflation of the tissue contacting surface.

1 45. A device as in claim 42, wherein the means for coupling with the heart
2 stabilizing member comprises a collet or socket for coupling with a ball on the heart
3 stabilizing member.

1 46. A device as in claim 42, wherein the means for coupling with the heart
2 stabilizing member comprises a clamp.

1 47. A device as in claim 42, wherein the means for coupling with the heart
2 stabilizing member comprises a slot for coupling with a surface feature on the heart
3 stabilizing device or the heart positioning device.

1 48. A device as in claim 42, wherein the means for coupling with the heart
2 stabilizing member comprises threads for coupling with complementary threads on the heart
3 stabilizing device or the heart positioning device.

1 49. A device as in claim 42, wherein the means for coupling with the heart
2 stabilizing member comprises a clamp.

1 50. A device as in claim 42, wherein the elongate coupling member further
2 includes at least one flexible joint between the proximal end and the distal end.

- 1 51. A device as in claim 50, wherein the at least one joint comprises a
2 collet or socket and ball joint.
- 1 52. A device as in claim 50, wherein the at least one joint comprises
2 multiple flexible beads.
- 1 53. A device as in claim 41 wherein the surgical tool is a heart positioning
2 member.
- 1 54. A device as in claim 53, wherein the heart positioning member
2 comprises:
3 at least one tissue contacting surface;
4 at least one suction aperture for applying suction force to enhance contact
5 between the tissue contacting surface and heart tissue; and
6 at least one suction port for connecting with a source of suction.
- 1 55. A device as in claim 53, wherein the heart positioning member
2 comprises:
3 at least one inflatable tissue contacting surface; and
4 at least one port for allowing inflation of the tissue contacting surface.
- 1 56. A device as in claim 53, wherein the means for coupling with the heart
2 positioning member comprises a collet or socket for coupling with a ball on the heart
3 positioning member.
- 1 57. A device as in claim 53, wherein the means for coupling with the heart
2 positioning member comprises a clamp.
- 1 58. A device as in claim 53, wherein the elongate coupling member further
2 includes at least one flexible joint between the proximal end and the distal end.
- 1 59. A device as in claim 58, wherein the at least one joint comprises a
2 collet or socket and ball joint.
- 1 60. A device as in claim 58, wherein the at least one joint comprises
2 multiple flexible beads.

1 61. A device as in claim 41 wherein the surgical tool comprises:
2 at least one inflatable tissue contacting surface; and
3 at least one port coupled with the tissue contacting surface for allowing
4 inflation of the surface.